DOCUMENT RESUME

ED 213 327 HE 014 785

TITLE	New Technologies for Higher Education. 1981 Current Issues in Higher Education, No. 5.
INSTITUTION	American Association for Higher Education, Washington, D.C.
PUB DATE	81
NOTE	22p.; Selected papers presented at the Annual National Conference of the American Association for Higher Education (Washington, DC, March 1981).
AVAILABLE FROM	American Association for Higher Education, One Dupont Circle, Suite 600, Washington, DC 20036 ($3.50 plus postage and handling).
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	Adult Students; Broadcast Television; Cable Television; *Computer Assisted Instruction; Consortia; *Delivery Systems; Educational Change; *Educational Technology; Extension Education; *Higher Education; Intercollegiate Cooperation; Microcomputers; Models; Nontraditional Education; Open Universities; Part Time Students; Teacher Role; Technological Advancement; *Telecommunications; *Telecourses
IDENTIFIERS	*Open University (Great Britain)

ABSTRACT

The applications of telecommunications technology, computers, and other technologies are addressed in five papers. In an overview, Raymond J. Lewis, Jr. suggests that colleges and universities are finding that telecommunication technologies offer cost effective ways of reaching adult learners, and that open broadcast television has been the primary vehicle for reaching off-campus students. In "What Makes a Telecourse?" Rodger A. Pool discusses television programs for instruction, the study guide, textbooks and reading, examinations, assignments, support services, and important new roles for the course instructor. In "Curriculum Issues in Telecommunications," Adele F. Seeff cites models of the educational use of telecommunications and describes the telecourse delivery system and full curriculum for off-campus students at the British Open University. A national consortium that is developing an American analogue is also described. In "Administration Issues in Telecommunications," Marlowe Froke suggests three major models by which new developments may be evaluated for inclusion in existing higher education institutions: the instructional services model, the miscellaneous model, and the open-learning model. In "Adapting to the Computer Revolution," John H. Strange suggests that the computer revolution is important to higher education because it will change the nature of work in society and will increasingly become a personal tool available to many people and will provide new means for transmitting data and instruction to the population without regard to their location. Additionally, business is beginning to invest in the use of computers for employee instruction and there will be an increasing amount of instructional software available. (SW)

1981 Current Issues in Higher Education, No. 5

New Technologies for Higher Education

ED213327

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One Dupont Circle, Suite 780
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The American Association for Higher Education is a national organization open to all individuals concerned with the value and effectiveness of higher education. Each year AAHE's National Conference on Higher Education brings together some 2,000 educational administrators, faculty, students, representatives of education agencies and associations, government and foundation officials, and others to discuss common concerns, disseminate effective educational practices, and focus on the future of higher education. The theme of the 1981 Conference was "Promising Frontiers: Five Partnerships for Higher Education."

Current Issues in Higher Education is based on topics addressed at the Conference. Selected papers presented at the Conference are included in the five monographs that make up the 1981 series. Several additional papers were prepared especially for publication here.

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Overview

Raymond J. Lewis, Jr.

Colleges and universities are finding telecommunications technologies offer cost-effective ways of reaching the growing numbers of adult learners.

We hear much these days about the rapidly expanding consumer market in home video and computers. Some go so far as to suggest that these devices, along with satellite and cable distribution networks, will eventually make obsolete the familiar college classroom with its face-to-face student/faculty interaction. While it is hard to deny the impact the electronic communications technologies are likely to have on many aspects of our lives in the relatively near future, the college classroom is hardly in danger of extinction.

There will always be students willing and able to pursue classroom education on college campuses and there will always be faculty who prefer the immediacy of the classroom. However, many educators and laypeople probably would be surprised to learn about the growing proportion of learners for whom the college campus is not a convenient place to learn. These students will be looking for alternatives to the campus classroom regardless of whether telecommunications technologies are available.

A very different enterprise

Higher education is now a very different enterprise from what it was in the 1950s when the emerging technologies of television and computers were being touted for their capacity to "revolutionize" the educational process. The access explosion has broadened the base of participation, the passage of the baby-boom population into adulthood has brought increased demands for lifelong learning options, and the declining proportion of 18- to 22-year-olds has diminished higher education's traditional market. The convergence of these developments in an era of double-digit inflation and severe fiscal constraints at all levels of government leaves the higher education community with strained resources and commitments to a clientele extraordinarily diverse in its age, sex, ethnic, and employment characteristics.

As colleges and universities find themselves serving more and more older learners, they also find it necessary to adjust to the competing demands of family, job, and community faced by their busy students. Changes in registration procedures, class schedules, financial aid policies, and curricular content all reflect efforts of institutions to adapt to the needs of their busy adult learners. Unfortunately, many of the alternative delivery systems such as satellite campuses and dispersed learning centers that were popular in the '60s and '70s prove too labor-intensive to be cost-effective in a period of financial constraint and rising energy costs. Using telecommunications technologies is one of the strategies many educators have turned to in an effort to meet student demands for convenient learning options and institutional needs for flexible, cost-effective, delivery systems.

Communications technologies are not unfamiliar resources to most educators. After all, as Marlowe Froke points out, the "instructional services model" has been with us for some time. The use by faculty of films, video, computers, and audiovisuals to support the classroom medium of instruction is a well-established pattern in American higher education. In addition to the fiscal disadvantages of being an add-on approach, the inherent advantages of this model can only be enjoyed by those learners for whom the campus is a convenient place to learn.

One of the ways that educational institutions have attempted to respond to their older, busier adult students has been to develop, within the existing administrative structure, separate delivery systems designed exclusively for those learners facing severe time and distance constraints. This mixed or "miscellaneous model," as Froke calls it, in many ways resembles the course-package approach of independent correspondence study with telecommunications technologies like television, radio, telephone, and computers serving as the vehicles of communication.

Whether or not the postsecondary community evolves

Raymond Lewis is research director of AAHE's Center for Learning and Telecommunications. He presented a version of this paper at the 1981 National Conference on Higher Education, March 4–6, in Washington, D.C.

any, or many examples of the "open-learning model" that Froke advocates, it is clear that there is much to be learned from the numerous "mixed" delivery systems that currently exist within the administrative confines of institutions whose primary educational mission is to provide classroom instruction in a campus setting. Such telecommunications delivery systems may often be "transitory," as Froke refers to them, but more importantly they may also serve as necessary transition phases in an evolution toward more flexible, decentralized educational institutions. If the educational delivery systems that currently employ one or more telecommunications technologies accomplish little more than to help the educational community adjust to the highly competitive world of in-home electronic technology described in John Strange's paper, they will have made a significant contribution.

Fortunately, these delivery systems also are teaching us some things about the process of distance learning and about those students for whom the campus is not always a convenient place to learn. Stepping back and taking a broad overview of these efforts may assist us in our efforts to anticipate what form, or forms, higher education institutions may be evolving toward.

Among the things we do know is that an increasing number of postsecondary institutions are becoming involved in the use of telecommunications. A 1979 Corporation for Public Broadcasting survey indicated that 71 percent of all colleges and universities use television for instructional purposes. Although many of these applications of the technology are closed-circuit, on-campus systems, we know from other evidence that television, radio, telephone, and computers increasingly are being used to overcome time and distance obstacles to educational access.

Most of the instructional uses of communications technologies occur at the lower-division undergraduate level and at the graduate/professional continuing education level. . . .there have been few upper-division undergraduate courses . . .

Most educational uses of telecommunications technologies are of an instructional nature. However, many institutions and agencies also use television, radio, telephone, or computers for outreach, career information, counseling, and public service programming as well.

Most of the instructional uses of communications technologies occur at the lower-division undergraduate level and at the graduate/professional continuing education level. Introductory core and elective social science and humanities courses are most common at the undergraduate level, but there is an increasing emphasis upon business and vocationally-oriented courses as well. At the post-baccalaureate level there is intense activity in engineering, medicine, and other high-technology fields where currency of information is highly valued. Most of the practicing professionals taking these courses via telecommunications do so for continuing education, but a significant minority are pursuing credit-bearing graduate courses toward a degree. Until recently there have been few upper-division undergraduate courses employing telecommunications.

As suggested earlier, we know that these learners who find it inconvenient to attend regularly scheduled, on-campus classes are usually employed on a full- or part-time basis, are in their late 20's or early 30's, have a higher-than-average level of educational attainment, and are trying to integrate more learning into an already busy life. In undergraduate courses there is a slightly higher proportion of women, whereas in professional continuing education there is a higher percentage of men.

The new technologies

Among the technologies, open broadcast television has been the primary vehicle for reaching the off-campus students. However, in the near future cable television is likely to far surpass both public and commercial open broadcast as the dominant technology as more major population centers are wired for cable. The use of public and commercial radio for instruction has been somewhat limited, although some colleges and National Public Radio are demonstrating a keen interest in expanding the use of radio/audio courses.

After open broadcast television, the most commonly used technology for providing instruction at a distance is the telephone. Unlike the open broadcast technologies, the telephone is interactive. When equipped to handle audio conferencing, it can link numerous students together with an instructor. The use of audio conferencing for instruction, has been pioneered by the University of Wisconsin Extension and is proving to be both extremely adaptable and relatively cost-effective. Variations of this technology seem to be proliferating rapidly.

With few exceptions, such as the University of Illinois Prison Project, the computer has not been used very much to serve students off campus, although it is used extensively on campuses for computer-assisted instruction. With the mushrooming availability of home computers and the potential of videodisc technology this situation will surely change in the near future. Some larger institutions such as Miami-Dade Community College do use the computer to help manage their distance learning programs. In spite of the obvious potential of videodiscs (especially when linked to computers), there do not currently appear to be any examples of them being used for distance learning, apart from some military and business applications.

The television course (telecourse), the radio course, and the audio conferencing network have, until recently, evolved rather separately. However, there is increasing evidence that

educators are more freely mixing television, radio, telephone and copy technologies (audio- and videotape) than was the case even a few years ago. We are likely to see more and more hybrid delivery systems that have been "customized" to meet local educational needs.

Among the things we are learning is that in spite of the high incidence of faculty resistance to the use of communications technologies for instructional purposes, those faculty who do become actively involved in it tend to be very supportive. This has been the experience at Dallas County Community College where, as Rodger Poole describes, faculty are heavily involved in the development and delivery of telecourses.

In spite of the technology's capacity to allow students to learn in isolation from faculty and one another, it is clear that most distance learners need and want an array of support services including telephone and personal contact with faculty, newsletters, feedback on tests and assignments as well as occasional classes. The telecourse model employed in Dallas is an excellent example of a delivery system that responds to this need for support and interaction.

Fortunately, there are, among those institutions experimenting with the use of telecommunications for distance learning, different approaches to using the technologies to convey course content. Some professional continuing education models use the technology to communicate all the content, while the telecourse model, among others, relies on the technology to convey 60 percent or more of the course content. Still others use the technology only as a supplement to printed texts and conveniently located classes. An example of this format is the University of Maryland's Open University, which is the parent model for the National University Consortium described by Adele Seeff. By studying these various combinations of technology, print, and classroom vehicles for conveying content to off-campus students, we can learn a great deal about the limits and possibilities of making higher education more flexible.

Of course, not all the experimentation with telecommunications is taking place at the individual institution level. Numerous consortia of colleges and universities are cooperatively producing and leasing courses on behalf of their regional membership, among them the Southern California Consortium for Community College Television and the Eastern Educational Consortium. Some programs initially developed to serve local educational needs have created nationwide consortia, such as University of Maryland's National University Consortium and Wayne State University's To Educate the People Consortium. Some states, like Indiana and Kansas, have statewide delivery systems while other organizations such as the University of Mid-America span entire regions. At the national level there are a growing number of satellite distribution networks—the Appalachian Community Service Network, the American Educational Television Network, and the Public Broadcasting Service's PTV-3. In the foreseeable future we are likely to see many other efforts to capitalize on the technological capacity that now exists to initiate educational programming from one location and reach learners all over the country.

As John Strange suggests, the higher education community may currently be ill-prepared to cope with the challenges and opportunities posed by the rapidly expanding in-home technology revolution. However, educators are better positioned to assess and respond to this changing environment precisely because numerous innovative colleagues have, for more than a decade, been actively experimenting with delivering learning via telecommunications. If higher education is to continue to serve students who either prefer to learn at home or find the campus inconvenient, it needs to carefully examine the lessons growing out of the crrent experiments with telecommunications.

What Makes A Telecourse?

Rodger A. Pool

A telecourse is much more than a non-commercial TV program. Backing up the new technology are study guides, textbooks, examinations, assignments, discussions, special communications tools, and important new roles for the course instructor.

My husband and I recently completed [DCCCD's telecourse] Earth, Sea, and Sky . . . Now retired and at or near 70, it is indeed a boon to us to be able to study comfortably at home without the frustrations of frequent travel and parking . . . Earth, Sea, and Sky seemed to us a very comprehensive course, well put together in all respects . . . We learned a lot we hadn't known before, or else had overlooked somehow in these intervening years of employment between educational spurts . . . Educational television is the best thing to have come along for those of us who cannot move about as freely as we once did.—Letter from Coastline Community College students enrolled in a telecourse produced by Dallas County Community College District

Essential to an understanding of what a telecourse is, is an understanding of what it is not. There is, simply stated, more to a telecourse than a series of television programs, and to succeed in such a course a student must do more than watch those programs. Neither is a telecourse simply a correspondence course to which pictures and a variety of other print components have been added. Rather, a telecourse is an instructional system designed "to examine and present a body of knowledge through the use of sight, sound, color, movement, and print in a manner that will stimulate and increase student involvement." (The essential features of this definition have been suggested by Tom Gripp, dean, College Development, Coastline Community College.)

In brief, a telecourse consists of both carefully designed print materials and video and audio elements. No single component can provide, nor is intended to provide, the complete learning experience. Instead, the print, visual, and aural elements work together. What follows is a brief description of 13 components that go into most telecourses.

Television programs. The television programs are, of course, the component that most obviously distinguishes a telecourse from other forms of instruction. Generally, a telecourse includes 26 to 30 half-hour television programs. The nature of the programs varies from lesson to lesson and from course to course. In some cases, they serve as the main vehicle for introducing and meeting a learning objective. In others, the programs illustrate a concept introduced through another component.

The television component is used to do what the medium seems to do best. For example, it appears that television can be used quite effectively to motivate students. It can vividly demonstrate applications, and it can bring to the student people, places, and events from around the world. It also can be used to highlight, to emphasize, and to influence attitudes.

On the other hand, the television programs cannot do certain things as well as other telecourse components. Detailed explanations, lists of facts, complex graphic displays, and routine drill and practice are better presented through other components, such as print. Obviously, where "hands-on" experience is required, neither television nor print can effectively replace the use of tangible objects and materials in shop or laboratory settings, though each of these components can provide support for the learner.

For the most part, telecourse producers have moved away from the "talking head" format in which an instructor is videotaped delivering a lecture. Instead, a variety of techniques are used including in- and out-of-studio interviews, on-location visits, documentary segments, dramatizations, demonstrations, clips from existing film footage, animation, and cartoons, to take full advantage of the potential of the medium.

Rodger Pool is director of instructional television for the Dallas County Community College District. He presented a version of this paper at the 1981 National Conference on Higher Education, March 4–6, in Washington, D.C.

The judicious scheduling of television programs can be an effective way of pacing student learning. In this regard, it is important for each program to be broadcast on a publicized schedule and, when possible, for each program to be broadcast at several times to accommodate students' needs. Additional airings also provide opportunities for review.

Study guide. The study guide provides carefully detailed directions for completing the course. Students consistently rank it as the single most helpful component of a telecourse. A study guide usually includes at least the following elements:

- Overview statement
- Lesson objectives
- Self-graded pretests and posttests
- List of key words and phrases
- Focus questions for the television programs
- Focus questions for readings
- Assignments (readings, study questions)
- Bibliographical references and suggested enrichment activities

The study guide also may present basic subject matter to elaborate on material presented elsewhere in the course, or to reinforce certain concepts.

Instructor. A telecourse instructor may play any one of several roles, or a combination of roles, depending upon institutional resources, the size of enrollment in the course, the nature of the delivery systems, and a variety of other considerations:

- Facilitator or manager who has primary responsibility for working with telecourse students and minimal responsibilities for traditional classroom teaching. Such an instructor typically relies heavily on the presentation of course content contained in the television programs and other course components.
- Discussion leader who conducts discussion sessions, seminars, and on-campus orientations.
- Lecturer who offers additional insights and analysis on campus or on a local radio or television station.
- Moderator who chairs symposiums and discussions.
- Evaluator who adapts examination material, designs new examination questions, administers and grades examinations, and provides written and oral feedback to students.

Most frequently a single telecourse instructor will play all of these roles. In the Dallas County Community College District, for example, each telecourse has at least one assigned instructor on each of the DCCCD campuses. Instructors conduct on-campus orientations and discussion meetings, schedule regular office hours for in-person or telephone conferences with students, maintain records, suggest test questions, evaluate completed tests and assignments, and determine final grades.

Because face-to-face contact is minimal, a telecourse instructor must make a special effort to communicate well with students through the few on-campus meetings, regular newsletters sent to students, student conferences, and other techniques. Though some courses such as composition, humanities, and laboratory sciences require more instructor time than others, the instructor plays an essential role in all telecourses.

Textbooks and readings. A telecourse typically includes readings and usually a textbook of some sort. Where appropriate, commercially published textbooks are integrated into the system. On occasion a new text is developed specifically to accompany the telecourse. In other cases, a separate reader pulls together readings for the telecourse. Generally, all required reading assignments are included in the materials "packaged" for use with telecourse. If required readings were not included in the package it would pose a significant problem for a telecourse student, because not all students have access to a library, and even if they did, it is unlikely that the library would have enough copies of a single work to accommodate the needs of all students enrolled in the telecourse.

Examinations. A telecourse generally will include two to four on-campus examinations, which can be machine graded. Most often, they are offered in a proctored test-center and scheduled for several times, such as on Friday evening and all day and evening on Saturday and Sunday. To help assure test security, telecourse producers create test banks for each course. Several questions are developed for each learning objective by a team of faculty, testing specialists, and instructional designers. The questions reference both specific learning objectives and levels of learning difficulty, so that "equivalent" test forms can be generated either by an instructor or by computer.

Assignments. Assignments usually are made in the study guide and may require the student to participate in a variety of learning activities. Each course requires some reading and writing. Earth, Sea, and Sky, when used as a laboratory science, requires both at-home and on-campus labs. In Our Own Image, DCCCD's introduction to humanities, involves students in creating art, evaluating the arts, and enjoying the arts, such as a trip to a museum and attendance at theatre and musical events. Dallas' freshman English composition telecourses require both on-campus and at-home compositions.

In making assignments it is important to keep in mind the characteristics and circumstances of those who are learning at a distance. For example, on-campus labs must be open at hours convenient for those who work full time, and reasonable make-up options must be provided.

Review cassettes. To make it as convenient as possible for students who may miss the open-circuit broadcast of television programs and for those wishing to review certain programs, institutions frequently make videocassette copies of the programs available in college learning resource centers, public resource centers, public libraries, and other community locations.

Student procedural guides. In most cases, telecourse students receive an information booklet providing calendars for all courses (tests, assignments, discussion groups, etc.); the complete instructional television broadcast schedule; and other useful information such as fees, residency requirements, and registration forms. In addition, many instructors give students a procedural guide to the particular course, including a syllabus with goals and objectives, criteria for grades, content outline, the instructor's campus office and phone numbers, and similar particulars.

Orientation sessions. Students generally are required to attend an orientation to the telecourse in which they are enrolled. Ideally, of course, such an orientation should be held in advance of the first broadcast. This meeting, usually conducted by the telecourse instructor, serves to introduce students to the course components, the subject matter, the students' responsibilities, and the involvement required to successfully complete the course. Such a session also serves to introduce the campus instructor and to reinforce the idea that help is readily available.

Discussion meetings. Typically, at various times during the semester telecourse students have an opportunity to meet and interact with fellow students. Instructors often plan special programs—a guest speaker, debate, or film, for example—but also allow for time to answer students' questions about examinations, course content, and telecourse procedures.

Newsletters. Often institutions send telecourse students newsletters, perhaps as many as three or four per semester, for each course in which they are enrolled. These communiques serve to remind them of important dates, note any changes in scheduling, refer them to pertinent campus and community events and services, and provide pointers for more successfuly study.

Telephone service. A number of institutions provide telephone "hotline" services for telecourse students. Hotline operators provide information about procedural questions and transfer students' calls to their instructors for answers about content and grades. Institutions serving wide geographical areas sometimes have installed incoming and outgoing WATS lines.

Computer support. Some institutions, notably Coastline Community College and Miami-Dade Community College, have found computer-managed instruction of great value in communicating with students. Miami-Dade's RSVP system (Response Systems with Variable Prescriptions) is a computer-based instructional management system that enables the institution both to score student responses and to provide individualized learning prescriptions.

Enrolling in a telecourse is obviously a convenient way for a student to earn college credit. However, students need more than an instructional system that provides mere convenience. They also need a system that provides a variety of opportunities for involvement and feedback. A thoughtfully designed telecourse can provide those opportunities.

Curriculum Issues in Telecommunications

Adele F. Seeff

Among the models for developing a telecourse delivery system into a full curriculum for off-campus students is the British Open University. A national consortium is working on an American analogue.

Historically the curriculum was transportable and ambulatory—students followed a peripatetic Socrates through the agora while he engaged in, naturally, a Socratic dialogue with them. Socrates produced, delivered, and was the curriculum, and the students came to him to receive it. In some ways, aspects of that tradition are still with us today, thousands of years later. The professor, according to one model, produces, delivers, and *is* the curriculum. He or she may insist that it is not so, encouraging students to read widely, discouraging them from regurgitating the substance of the lectures, even fostering some original thought—but the unconscious contract between student and professor insists that the professor *is* the curriculum, and complex administrative and accounting systems and the professor's promotion demand it.

But now that we have a few post-Socratic technological revolutions under our belt—the invention of movable type, a postal system, telephone, radio, television, satellites, computers, and the combination of several of these technologies—the curriculum is being brought to the student, with the support of telecommunications.

The educational models using telecommunications today are not unfamiliar. The oldest and probably most systematic users are the community and junior colleges from whose ranks come the principal producers of telecourses—Coastline Community College, Miami-Dade, and Dallas County Community College District. When I use the term "telecourse," I am referring to a course at the lower level, offered for credit or non-credit, on campus or through an off-campus division, in which the creation of the print materials has followed, or been prompted by, the production of a television series of about 30 half-hour programs on a single subject area. In these instances, the television is heavily didactic, and tends to replicate the content of the printed materials. The accompanying text has self-assessment exercises; and varying student support services enrich the student's experience such as a WATS line, television discussion followed by interactive audio, computer-assisted instruction, or weekly, bi-weekly, or weekend seminars.

However the telecourse is delivered—in terms of the technology and accompanying student support services—it remains a single course production effort, extremely expensive to support, marketed singly, and not intended as part of a sequential curriculum leading to a degree. Further, when the program is a component of a three-credit course, it may consume an hour of air time per week, which can present a problem for some public broadcasting stations. In some cases, cable television has solved, or will solve, that problem.

A variation on the telecourse is the wraparound series, such as "The Shakespeare Plays" or "The Shock of the New," where the educational institution offers the course in accordance with a prearranged air schedule. These courses may suffer from insufficient lead time for institutional planning and preparation of ancillary print materials.

Other models of the educational use of telecommunications include:

To Educate the People Consortium, a consortium of institutions offering a program of interdisciplinary studies directed primarily at blue-collar and low-status white-collar workers, which incorporates telecourses as part of the program.

Appalachian Community Services Network provides undergraduate, graduate, and professional training programs over some 50 cable systems, and stresses its mandate to serve community needs and interests.

American Educational Television Network is a commercial enterprise marketing professional training programs.

PTV-3, one of the operating divisions of the Public Broadcasting Service, is launching this fall a new Adult Learning Program through partnerships between participating PBS stations around the country and individual colleges and universi-

Adele Seeff is assistant director of the National University Consortium for Telecommunications in Teaching, based at the University of Maryland, College Park. She presented a version of this paper at the 1981 National Conference on Higher Education, March 4–6, in Washington, D.C.

ties. The program will offer a selection of telecourses and two wraparound courses.

The Grand Alliance is still in the planning stages at PBS. It is conceived as a cooperative endeavor with cultural and higher education institutions to bring these institutions' programs into the home through pay television.

In addition, businesses are spending billions of dollars training their personnel, and many of these training efforts involve telecommunications—videotape and videodisc programs, teleconferencing, and so forth.

What can we learn from all this activity? Nothing that we don't already know.

- That there is a diverse student population that can and wants to be served in a diversity of ways.
- That a curriculum using telecommunications is reaching an ever growing part-time adult student population that needs or chooses to be freed from time and place constraints.
- That this population wants a degree ultimately and wants to select a combination of courses and support services.
- That courses using television in the way television should be used are astronomically expensive to produce.
- That single-course marketing is a problem and does not always produce economies of scale.
- That a telecommunications-assisted program demands partnership—collaboration between institutions of higher education and educational television, and, as important, collaboration between faculty and the promoters of such a curriculum, whether it be in the development of the curriculum, its delivery, its approval, or simply seeing it as another teaching resource. The partnership between administrators in higher education and educational television is being forged. We have yet to nurture the other partnership.

Lessons from another model: the British Open University

Before I suggest what the nature of that collaboration might be, I would like to look at another educational model using telecommunications. Across the Atlantic back in 1969, the British Open University was chartered as an undergraduate and graduate degree-granting institution with a mission to serve "second chance" adults. These are adults who have been closed out of the rigorous path to British universities, and who no longer have the luxury of suspending their obligations to family or work in order to attend a university full-time, even if they could pass the entrance examinations. Sponsored and backed by Harold Wilson's Labor Government, and an annual budget of approximately $90 million, the British Open University, in partnership with the BBC, has been one of the stunning successes in higher education, enrolling annually 80,000 students (who would not otherwise have attended a university), and awarding some 30,000 degrees.

The British Open University curriculum includes a running total of about 130 courses at the upper and lower levels, many of them interdisciplinary.

The reasons for the British Open University's success are not hard to find: recognition of the needs of a huge population of adult learners who want to control their own study hours, use of television and audiocassettes, a mix of student support services, and most important, the key role of faculty in developing the curriculum.

. . . the British Open University, in partnership with the BBC, has been one of the stunning successes in higher education, enrolling annually 80,000 students (who would not otherwise have attended a university), and awarding some 30,000 degrees.

The development of this curriculum merits some attention. The British Open University has a full-time faculty but their primary responsibility is not to teach classes, but to function as team members in the creation of multimedia courses.

A committee of academic deans sits in judgment on course proposals and a successful proposal results in a course team of academics who are specialists in their particular discipline, representatives from the BBC production staff, and an educational technologist or instructional designer. That team will spend three years and half a million dollars producing an intellectually elegantly structured course, so rigorous that an upper-level example compares favorably with a graduate course in the U.S.—so rigorous that Open University became a misnomer because the sophistication of the materials demanded such a high degree of self-selection on the part of potential students.

Each course consists of a formidable print package. The core is the weekly study guide or unit text. The study guide functions as the traditional classroom lecture would, guiding the student through a single week's reading, which includes supplementary textbooks. The guide is interactive; it conducts an ongoing dialogue between author and student reader in which the author questions the student, comments on possible answers, discusses the readings, and allows the student time to pause, reflect, and synthesize. In addition, there are audiocassettes, and, depending on the course, there might be phonograph records, a science kit, or a home computer. Then there is television. The television programs constitute five percent of the total package. Every other week there is a broadcast, aired by the BBC. Television is not used didactically; it is used for enrichment—to motivate and pace students. It adds the visual dimension beyond the printed page. The content of the television programs is tangential to, illustrative of the printed content. It never replicates the print.

In addition to this instructional package, sent to students

through the mail, is the opportunity for face-to-face instruction. This takes place at weekly study centers where students may go, if they choose, to establish a relationship with their facilitator, who might lead a discussion, help solve problems, or grade papers and exams. Some courses also offer a summer school where students have the opportunity to attend full-time in a university setting.

These courses run for either a year or a half year and are worth a full credit or a half-credit respectively. A bachelor's degree in the United Kingdom requires six full credits and therefore it takes a student six years to earn a degree.

What lessons can be drawn from this model for American higher education? Some of the lessons are very clear: We cannot centralize education, organizationally or financially, in this country. Education is not the business of the federal government, but of the states. We cannot centralize delivery of the video portion of a course without a BBC—public broadcasting is a regional matter, too.

However, the British model also shows that a coherent curriculum leading to a degree is of paramount importance to adult students today; that the ingredients of print, technologies, and face-to-face instruction work well for adult students; that production costs must be shared among multiple users; and that faculty have a key role to play.

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The University of Maryland University College absorbed these lessons and applied them to the Washington-Baltimore area. In 1972 it grafted one British Open University course onto its adult education curriculum with such success that the University of Maryland Open University was created as part of the University College, which is a separate, degree-granting adult education institution within the University of Maryland. Today it enrolls 2,400 students annually. Along the way, the University of Maryland Open University established a significant partnership with the Maryland Center for Public Broadcasting, a producer of high-quality programming involved in its own consortium, the Maryland College of the Air.

Creating an American analogue

When the idea for the National University Consortium was germinating in a creative zone somewhere between the University of Maryland and the Maryland Center for Public Broadcasting, the initial proposal to Carnegie Corporation of New York called for a study to determine the feasibility of establishing an analogue to the British Open University in the United States. What we have established instead is a consortium that recognizes the essential characteristics of American higher education: the autonomy of the states and the individuality of all institutions.

Through a national network of member institutions—10 four-year colleges and universities each paired with a public broadcasting station or cable system, and four independent television stations—the National University Consortium this year is offering British courses, adapted to the needs of American students, two telecourses developed by the Maryland Center for Public Broadcasting, and a course called Exploring Language, which was produced with the course team model used by the British Open University.

The member college sets it own tuition, awards the credit, and decides on the appropriate student support services. The television station or cable system broadcasting the video portion of the course works cooperatively with its college to arrange a broadcast schedule. The consortium maintains its identity as a service organization, committed to increasing educational opportunities for part-time, degree-seeking adult students. These educational opportunities occur through the network of member colleges. The consortium recognizes and respects the individual college's autonomy and special characteristics, and each college offers the courses in its own style. The consortium makes recommendations; individual colleges may accept or reject them.

The essential design of the curriculum—interdisciplinarity and the interactive quality of the texts—has been preserved: Courses are offered in one of three concentrations, the humanities, the social and behavioral sciences, and technology and management. A course runs for an 18-week semester and is worth either nine or six credits. (If it takes the British student six credits at one credit per year to earn a B.A., then one British credit is worth 20 American credits. A half-credit, by this system, is worth 10 American credits. And this is rounded down to nine credits, a multiple of the hewn-in-stone three-credit course.)

American higher education cannot develop a credit bank or standardized tuition or instruction, but it increasingly will have to share resources—witness the growing numbers of consortial arrangements. The National University Consortium model structures the conditions for sharing an existing high-quality, multimedia curriculum leading to a degree. The consortium plans to offer the courses so that over a six-year period a student taking our offerings can complete his or her baccalaureate degree. It is not anticipated that students will take only consortium courses; they will mix and match. Consortium membership fees will go toward the creation of new courses using existing technology. An advisory council, selected from within and beyond the membership, advises on course selection and development, a process that is coming more and more to involve faculty from member schools.

Our experience tells us that adult part-time students are well served by courses that carry large credit blocks (accelerating an otherwise painfully slow route to a degree), courses that use television to enrich but leave the largest share of

instruction to print, courses that come with optional support services.

The curriculum works pedagogically but its implementation raises some difficult issues for faculty. Interestingly enough, the large credit blocks have posed no problem. Neither is there a problem with an extended semester. Two crucial factors are responsible for overcoming faculty resistance to courses whose origins lie elsewhere. One factor is the self-evident quality of the materials themselves. The second is the emphasis on faculty control and ownership. Once a school approves and accepts a course, that course belongs to the school, to be offered in the manner that particular school deems appropriate. Faculty should be involved at the outset in the review process. They should be offered participation in course selection, adaptation, and development.

The consortium is demonstrating that it is learning the lessons taught by the British Open University. A course team drawn from faculty from member institutions has been assembled to begin work on a multimedia, nine-credit course entitled The Future: Prediction, Design, and Management. Over the course of the next two years, faculty from Pennsylvania State University, the University of Delaware, and Rhode Island College will work together selecting areas of study, writing materials, and producing television programs. Their goal is to create educational materials of the highest quality for the adult degree-track student. To achieve this goal, members of the course team must balance cooperative creativity against individual talent.

What lies ahead in the colleges and universities is a system of reward based on course production using telecommunications, just as faculty reward systems currently are based on the production of other forms of communication, namely books and articles. The reward system will have to be modified, since the role of the faculty member in producing course material involving telecommunications is not the traditional research university model. But then, the relationship between the teacher and the adult part-time student is not the same as that with the full-time, on-campus, 18-year-old student.

Today's nursery school children will be undergraduates in the 21st century. Alongside of them will march an ever-growing army of lifelong learners, adult students whose needs and learning patterns will have an enormous impact on the way higher education is packaged and delivered in a society, whose technological options will be many and varied.

Our roles as educators will be transformed. We must let go of some of our traditional assumptions and accept and produce change; we must prize collaboration as well as autonomy. We believe the National University Consortium has made a beginning.

Administration Issues in Telecommunications

Marlowe Froke

Three models illustrate the way telecommunications can be integrated into higher education's administrative structure.

I would like to approach the general topic of administrative perspectives on telecommunications from the point of view of personal experience during the years that I've been in the field, and I'm going to set aside such words as cablecasting, uplinks and downlinks, transponders, software, hardware, and most of the acronyms and names of new agencies and organizations that now flow, almost, trippingly over the tongue. I suggest that there are three major models, familiar to higher education, by which all of the new developments might be evaluated and discarded or assimilated into existing institutions.

My models might be oversimplification to the sophisticated communications, telecommunications, or telematics specialists, but I think they might be useful. As with all models, each of you will be able to identify exceptions to my characterizations. And, as with all models, there is overlap to one degree or another, although in the application of the models it is relatively easy to observe the emphasis in any given institution.

Three education models

The three models are the instructional services model; the miscellaneous model; and the open-learning model. All three models are observable whether one is dealing with print, audio, film, video, or computer display. And all three models are observable regardless of the distribution technology—the mails, radio and television broadcast, cablecasting, closed circuit, satellite distribution, or direct retail to consumers of various learning packages to be used on personal audiocassettes, videocassettes, videodiscs, or computers. All three models are in use whether an institution is primarily a user of instructional materials, a producer and distributor of instructional materials, or a combination of the two.

The distinction between user and producer is of interest because of the different ways in which communications technologies have been introduced into higher education. With the exception of the university presses, individual institutions of higher education really have never been in the business of textbook and reference book publishing. Rather than an institutional capability, higher education has relied on arrangements between individual faculty and the commercial publishing industry and hoped that through some kind of random activity in the marketplace the needs would be met. The college and university libraries became the depository for the output of commercial publishers. And the faculty built their courses, more or less, around one or several books published by those firms.

The same approach evolved with the educational film industry. For the most part the films used in colleges and universities, as well as in other levels of education, come from businesses that use individual faculty as consultants or in other roles in the planning and production of the films. There is not much of an institutional commitment, and even less today because of the skyrocketing costs of film. As with the book publishing industry, individual institutions of higher education are markets and depositories for the output of the educational film industry.

It was with the radio and television technologies that higher education became involved, as institutions, producing instructional materials. And while production is shifting toward agencies other than institutions of higher education, there is still a compulsion, if you will, by colleges and universities to produce their own materials.

One can speculate about the reasons for this. One reason rests in the historical fact that colleges and universities were leaders in identifying the need for a national policy in allocating some parts of the radio broadcasting spectrum for noncommercial users. They advanced the same theme with television and were successful. But even before the allocations arguments, some colleges and universities had established

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Marlowe Froke is director, Media and Learning Resources, Commonwealth Education Network, Pennsylvania State University. *He presented a version of this paper at the 1981 National Conference on Higher Education, March 4–6, in Washington, D.C.*

radio stations, and in the 19-teens, a few colleges were blasting signals all over the country. Modern-day telecommunications specialists can be humbled by looking at some of the accomplishments in those days. Then there were courses by radio and some universities even used local newspapers to print the weekly lessons that accompanied the broadcasts.

These diversions in introducing my three models do have some purpose. Administrators with an eye to economics probably would be well advised to look to the institutional relationships of higher education to the book and film industries as they determine the use of their limited financial resources. Being a user—an educated consumer—of instructional materials, regardless of the medium, is probably the most effective way to be introduced to the telecommunications media. And thus the first model.

The instructional services model

The instructional services model is already in place. The word "services" aptly states a certain type of relationship to the main organizational structure of the college or university. Today almost all colleges and universities are organized around the classroom medium of instruction. Instructional services means that the other media are used by the faculty to supplement, complement, enrich, and embolden what takes place in the classroom. Books, film, video, computer programs, and all sorts of other so-called audiovisual aids fall into this pattern.

The model works. Individual faculty pick and choose the components of the courses and display them in varying quantities in the context of the classroom medium. The only thing that is wrong with the model is that it is a dead-end in cost effectiveness. For as an administrator builds on the model the costs of the basic organizational medium—the classroom—are retained and all of the other costs are add-ons. There probably is a limit to the improvement or effectiveness of instruction that can be justified in this model. The rationale or, as faculty perceive it, the irrational administrative control of the model is to restrict the funds available for the purchase of books, films, and other instructional aids. And all of us are familiar with the problem of trying to keep up with the output of the media producers. The strength of the model rests in the process of evaluation and selection of the materials by the faculty. The weakness of the model rests in the inability of the administrator to satisfy the faculty appetite for the materials that are available.

The miscellaneous model

The second model is what I've called the miscellaneous model. Currently we plan, organize, and produce discrete units of media materials and make them courses—packages, so to speak. The miscellaneous model has evolved from the various attempts by educational institutions and other agencies, including commercial and noncommercial production houses, to create complete courses for use by colleges and universities. The packages have been introduced with a wide variety of motivations. With correspondence study, the medium was the textbook and the study guide for the independent learner. One of television's earliest representations was the master teacher— a perceived need to give the quality experience of a master teacher to a larger number of students. Another motivation has been financial. With rising costs in higher education, the television medium, for example, has been used to distribute a single classroom presentation to students in other classrooms or other locations. Broadcasters might characterize it as special-events coverage, taking the presentation prepared for another medium and distributing it through television. The most recent motivation for the miscellaneous model is either the idealistic wish to provide learning opportunities for adults or to provide a new clientele—adult students—to help contribute to the survival of the institution.

The involvement of the faculty of an individual institution in the packages, the courses, varies. With some institutions, the degree of involvement is rigorous. With others, the decision to offer the course is primarily administrative and from a faculty point of view it is out of sight, out of mind.

The miscellaneous offerings lack coherence, unity, and long-term educational purpose. They fail to become part of the internal academic organization of a college or university.

The miscellaneous model can be characterized as transitory. Individual applications are here today and gone tomorrow because of some weakness in the overall model. When the master teacher leaves the institution or retires, what was done disappears. When a faculty member, paid extra to develop a television course, finishes the job, he or she returns to the academic department and the classroom pattern. When a particular enrollment crisis is over, the application of television is set aside. When rights expire for certain course components that are broadcast on a public television station, the course disappears. In application of the model, no institutional commitment has been made by higher education, and other organizations and agencies that are involved as a part of the model move on to other things or other contract and grant opportunities.

The miscellaneous model is characterized by a wide variety of motivations. Invariably someone or some part in the model is being exploited by another. The miscellaneous offerings lack coherence, unity, and long-term educational purpose. They fail to become a part of the internal academic organization of a college or university. The miscellaneous model serves a purpose in introducing more people to the alternate media and how they might be used, but it, too, is a dead-end unless one can find a way to articulate the miscellaneous offerings as a part of the whole.

The open-learning model

My third model is what I call the open-learning model. It is an alternate to the classroom model that dominates all of education. It is based on the reality of an age that is being characterized as the Communications Age, with technologies of a scale and scope that make possible establishment of totally new instructional systems that accommodate individual differences of learners and are flexible and accessible from the learner's point of view.

The third model is not really revolutionary, for its basic design was accomplished almost a century ago in the lowly regarded correspondence study programs. When the University of Chicago introduced the new system to this country, the faculty were regarded as having new roles in the use of the print media and in the distribution technologies of a fairly reliable mail system. The relationships between faculty and students were to be different, and they were. And separate administrative and academic services were created, admittedly in rudimentary form, to accommodate the rather dramatic principle of continuous registration.

Correspondence study, unlike other representations of the newer media that came to higher education, was introduced with attention to not only instruction, but also the academic and administrative services that are necessary to make it work. And correspondence study was introduced in a manner that made it possible for students to achieve long-term educational goals. A curriculum was developed and maintained until in many institutions the method came upon hard times.

It is this type of model, an open-learning model, that probably deserves most attention by academic administrators. How can one adapt and modify an institution heavily oriented toward the classroom medium so that it accommodates not only the system that has grown up around the classroom but also introduce a totally new instructional system that deals with the new media on their own terms?

The introduction of such a system requires new perspectives on teaching, learning, and academic and administrative services in higher education.

Adapting to the Computer Revolution

John H. Strange

Computers hold great promise for higher education—but only if educators go after the new technologies as aggressively as their next generation of students is doing.

It is hard to realize, given the pervasive impact of computers on our society, that the first computer was not completed until 1946 and, until the early 1950s no one expected computers to be more numerous than a dozen or so huge machines. Today widespread home and business use accounts for the recent success of Radio Shack, Apple, and other "personal" computers. It is important for those of us in higher education to begin to think about the implications of this computer revolution.

Computers already have affected education, perhaps more than any other recent technological innovation with the possible exception of the Xerox copying equipment. But the impact has been insignificant to date compared to that coming in the next decade. We have experienced enormous growth in the use of computers in research, resulting in more and different research by our faculties. New disciplines and new technologies have emerged in the past 30 years in communications, engineering, space exploration, and many other fields. Faculties have demanded significant budget allocations for instruction and research.

The impact of computers also has been enormous in record-keeping and administration, making it possible to manage much larger and more complex educational institutions. And computers probably could be said to be largely responsible for privacy legislation that has complicated much of what we do, by creating volumes of personal information that is easily accessed by large numbers of people. But these and many other changes will look insignificant when compared with those changes that are lying ahead for us in the coming decade.

Two types of impact

I believe that the impact of the computer revolution on education, and more particularly higher education, will be of two general types. First, it is clear that computers very shortly will radically alter the nature of work in our society, especially in manufacturing where large numbers of production jobs will be eliminated. The president of Fiat Motor Company has said that Fiat could produce as many cars as is does today with only 10 percent of its current work force when it fully implements a robotized manufacturing line. Robotization of automobile production facilities is already underway in Japan, and has begun in the United States. Christopher Evans, in *The Micro Millennium*, says that the work week will decrease to 20 hours in the next decade. The consequences of this radical change in the world of work will have great impact on the world of higher education.

The second source of change in higher education in the next decade will stem from the impact of the computer on instruction. There has been some effect already, but it has not yet been significant. In the next decade that will change for at least two reasons. First, the computer will truly become a personal tool; it will be owned by, or easily available to practically every person in our society. The personalization of computers will provide an entirely new method for transmitting data and instruction to a population without regard to their location or proximity to educational institutions. Second, the personal computer is now being used, sometimes in conjunction with the laser videodisc player, to provide interactive instruction for industrial employees.

The technology is in its infancy, but already has been shown to be a potentially powerful and very cost effective instructional tool. The laser videodisc system is among the most versatile of the new devices. It is capable of storing 54,000 frames of information—think of them as slides of pictures or text material, but they could also be the frames that make up motion pictures or videotapes. The information can be accessed in any order, as stills or in motion, and when in motion accompanied by two audiotracks. The two-track audio system could provide instruction in two different languages, at two different skill levels, for teacher or student

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John H. Strange is vice president of the Council for the Advancement of Experiential Learning, in Columbia, Maryland. *He presented a version of this paper at the 1981 National Conference on Higher Education, March 4–6, in Washington, D.C.*

information, or any number of combinations. The videodisc-microcomputer combination allows one to create an instructional program of great complexity and size using color slides, color videotapes, or film, and vast quantities of data. The cost of the equipment for a student station is about $7,000 today, and can be expected to decrease significantly over the next few years.

If you are having trouble imagining how such equipment could be used, think for a moment of an art history course that could be "programmed" so that any of 54,000 slides would appear on the screen, depending on responses made by a student operating the microcomputer attached to the videodisc and a color television set. Or, think of a complex simulation of congressional politics that could be developed with situations, facts, changing information, accompanied by tapes of real or simulated events. The potential is enormous.

But it won't happen

Many of my peers caution me that this great revolutionary change in education will not occur, or at least not with the intensity and thoroughness that I predict. Their arguments are many; the most frequent argument is that the systems are too expensive. This, I think, is incorrect. By 1985, personal computers are expected to cost a little more than 1 percent of an average worker's annual take-home pay. Videodisc systems already are available in quantity for less than $2,000, and the price will decline in the next few years. Remember the cost of pocket calculators just five years ago?

The other popular argument is that changes will not occur because people will resist. Perhaps educators will resist. Christopher Evans and many others suggest that the era of electronics will have a greater and more rapid impact on society than did the industrial revolution. Many observers argue that the new Luddites will be concentrated in our educational institutions, and the faculties will lead the resistance to the introduction of the new technologies.

Many observers argue that the new Luddites will be concentrated in our educational institutions, and the faculties will lead the resistance to the introduction of the new technologies.

But our young people are not resisting. High school students, grammar school students, and even pre-school children are exposed to the realm of computers and eager to own one. They flock to computer stores and computer fairs. They are forming computer clubs in great number. They are purchasing computer games in unprecedented quantities. And they are getting their introduction to personal computers in school. This is partially a result of the marketing strategies of the personal computer companies. They are making it easy for future buyers to get access to machines now, to become familiar with them, and to become accustomed to using computers as a regular part of their lives. Five years from now, or even less, the cost of the machines will be considerably lower. The marketing experts ask whether anyone seriously believes they will have trouble selling machines to the students now in high schools, students who are regularly exposed to personal computers. There will be no resistance.

Surmounting the software problem

Admittedly, the limited quantity of educational software is one of the reasons that computers have not already had a greater impact on instructional activities. But this is about to change. We are unleashing large numbers of teenagers into software development. First they buy programs, most often games, from the wide variety available. Then they buy books and copy prewritten programs to save money. Later on they begin to write their own programs, again primarily games. In time they begin to write much more complicated programs, including instructional programs of considerable complexity and sophistication.

Amateur programming can be expected because computer languages are becoming much easier to use. Author languages, such as PILOT, make it possible for anyone to write very simple, yet functionally complex programs. The recent technological developments have resulted in very inexpensive computers that operate quite rapidly and have enormous memory capacities. Because speed and memory space are no longer costly for the buyers, it becomes less important to be "efficient" in programming, a significant issue for the amateur programmer.

Finally, business is beginning to invest significant sums of money in the use of computers for employee instruction. Many companies, especially those in communications and information (such as AT&T, Dow Jones, virtually every major publisher in the country, and television and radio stations) are investing heavily in research. They are all developing the capability to deliver information directly to the consumer. Some publishers privately predict that printed books will be replaced by the videodisc within the next decade. It is already possible to acquire a videodisc of the text and pictures for all patents ever issued in the United States. Readers Digest, which recently bought The Source, a national computer data and information service, is only one of several magazine publishers attending to the future by making sure that they can provide customers with information electronically. This huge investment by business and industry will result in highly sophisticated and effective instructional programs, making full use of the technical capabilities of microcomputers at a cost their customers can afford. They believe the financial rewards will fully justify this enormous investment.

There will be an increasing amount of instructional software available, but it is my prediction that it will be developed primarily by people in industry. Also it likely will not be disseminated through educational institutions, but directly to in-

dividual users. I see this to be the most profound of the changes that lie ahead. Instruction no longer will be the result of a course prepared by an individual and delivered by an educational institution to groups of students. Rather, courses will be developed by teams, delivered in a variety of ways directly to individual consumers. The implications of this change are far-reaching.

The argument that computer-assisted instruction is dull and dehumanizing is often made by those who have tried to use some of the initial computer-assisted packages developed over the past 15 years. Certainly the general thrust of this argument is correct. However, I believe that the combination of the microcomputer with videodisc provides the opportunity for instruction of a much more complex and exciting type. And it is also being shown that the computer, when a tool of the learner (that is, controlled by rather then controlling the learner), can be one of the most powerful methods of instruction.

Seymour Papert, in *Mindstorms: Children, Computers and Powerful Ideas*, demonstrates very clearly that a computer can be an effective learning tool for children as young as 4 or 5. By using the computer as a tool they encounter extremely complex ideas; they learn how to formulate and solve problems that they or others construct; they learn math skills, writing skills, analytical skills, and even physical skills such as juggling. Papert's research demonstrates that the computer can be used effectively by even those children determined by our educational system to be "poor learners." Furthermore, the sex, race, and socioeconomic background of the children appear to be irrelevant in the extent to which they use the computer as a tool for learning.

This phenomenon has also been reported in the press, primarily through interviews with students, whose self-confidence, curiosity, willingness to explore is evident and which is attributed, by them, to their understanding that the computer is a tool they can master and use.

Implications for higher education

Assuming that I am correct in predicting that the potential roadblocks to change will not be effective, what are likely to be the implications of this new computer revolution on higher education? It is entirely possible that educational institutions, as we know them today, will be either radically transformed or replaced within the next decade. Although Papert talks about secondary schools, his argument also is generally applicable to postsecondary institutions:

> *For people in the teaching professions, the word "education" tends to evoke "teaching," particularly classroom teaching. The goal of education research tends therefore to be focused on how to improve classroom teaching. But if the model of successful learning is the way a child learns to talk, a process that takes place without deliberate and organized teaching, the goal set is very different. I see the classroom as an artificial and inefficient learning environment that society has been forced to invent because its informal environments fail in certain essential learning domains, such as writing or grammar or school math. I believe that the computer presence will enable us to so modify the learning environment outside the classrooms that much if not all the knowledge schools presently try to teach with such pain and expense and such limited success will be learned, as the child learns to talk, painlessly, successfully, and without organized instruction. This obviously implies that schools as we know them today will have no place in the future. But it is an open question whether they will adapt by transforming themselves into something new or wither away and be replaced.*

Business is becoming a prime competitor of colleges and universities in providing educational services. It has the capital to invest in the development of hardware and software, it has access to the best research and development staffs, and it is creating linkages to the consumers who will be purchasing or using the educational materials it generates for its employees and others. Higher education will have to meet the challenge presented by business if it is to retain its viability.

Even if colleges and universities are not faced with imminent demise, the new technologies will require changes in our methods and content of instruction. For example, much of the instruction in higher education has centered on the development of techniques to assist students in acquiring considerable bodies of knowledge or facts. We divide ourselves into disciplines according to the particular set of factual information that we have at our command. We test for facts; we give grades based on the acquisition and retention, at least for a short time, of factual information. In the future though, computers will make available enormous data banks and organize and index those facts so that they can be accessed, combined, and reviewed from practically any vantage point. No longer will educators be the primary source of factual information, and we will have to adjust our teaching approach accordingly. I happen to think that this is a very positive development, for I believe that we, as educators, are too often concerned with facts and too infrequently explicitly involved with the teaching of cognitive, affective, and interpersonal skills, and those essential mathematics, writing, and communication skills.

The use of computers provides a unique opportunity to teach critical thinking and cognitive skills. Not only can the computer be a tool for this purpose, it also can provide the opportunity for very complex and detailed simulations that offer realistic opportunities for students to develop, improve, and exhibit thinking and decision-making capabilities. Perhaps no other implication of the computer revolution is more important for higher education.

Educators describe their students using affective descriptors, such as curiosity, determination, creativity, challenging old ideas, being able to handle ambiguous situations, and being able to adapt quickly to technological change. They

speak favorably of students who complete tasks on time, who incorporate into their thinking information and approaches from a variety of sources. And yet educators, and I include myself, fail to identify explicit improvement in these areas as important parts of the teaching process. We fail to make it an explicit objective to increase curiosity. We fail to recognize progress achieved through expanded creativity. Much of this can be changed through the use of computers because, as Papert demonstrates, computers allow students to experiment, express their curiosity, demonstrate their creativity, and master ambiguous situations. Moreover, the computer provides an excellent opportunity to observe and record these changes and the development of these affective skills.

. . . much of what we now consider to be available only in libraries will be available inexpensively in homes: Within five years you will be able to purchase for less than $500 the equivalent of 10,000 books on videodisc or microcomputer storage.

Electronic media increasingly will become the common storage device for data and information. Libraries will become centers where one obtains videotapes, videodiscs, and computer discs. Libraries will have microcomputers and videoplayers available for use. When we stop to think that the entire collection of the Library of Congress can be stored on videodisc, taking no more space than an average living room wall, then one can imagine the changes necessary in the physical storage capacity of libraries. In fact, much of what we now consider to be available only in libraries will be available inexpensively in homes: Within five years you will be able to purchase for less than $500 the equivalent of 10,000 books on videodisc or microcomputer storage.

The new technology also will play a major role in serving the special needs of handicapped and adult students. Low cost personal computer equipment is being developed that will "read" to blind students. Other computers scan printed material and convert it to Braille. Blind users can also type into a microcomputer and print out in either Braille or standard print. Those with hearing impairments find the visual text of computers, videodiscs, and players enormously helpful to their educational activities. Some computers are able to accept instruction by voice, or by sensors attached to various parts of the body. These developments will help higher education attend to the needs of handicapped learners.

Institutions that have not yet successfully adapted their procedures and courses to the needs of adult students will find the new technology will force them into flexibility. The combination of videodisc and microcomputer will permit the direct delivery of educational services to homes or worksites, at convenient times, and in a format that is paced to the learner's individual needs. The workplace need not be seen only as a field of competition. Indeed, as microcomputers make headroads into the office, they also expand the opportunities for education there. Word processors, soon a fixture in every office, can be learning stations for employees to use before and after work or during breaks. These new delivery mechanisms offer great potential for higher education to reach new clienteles.

Computers for counseling

Another opportunity the new technology affords is to improve our counseling of students. One of the most important developments in counseling today is the spreading use of interactive microcomputer programs to assist in career and educational counseling. SIGI and DISCOVER are being used by significant numbers of counseling centers to provide affective counseling support and information to large numbers of students. When first introduced, these systems met resistance from counselors who feared their jobs would be eliminated, that the human aspect of counseling would be deemphasied, or that the use of computers would result in a student accepting a "machine recommendation" as the only alternative to be considered. After extensive use in many institutional settings, counselors now find that DISCOVER, SIGI, and other such computer-assisted programs allow them to spend their time in counseling students, rather than collecting and disseminating information. They are able to serve many more students with the same number of staff members. And students come to them better informed, with many more ideas about vocational and educational opportunities.

The Council for the Advancement of Experiential Learning has recently developed Comp-LEARN, a microcomputer program to assist students in identifying skills and knowledge acquired experientially and teach them how to compile a portfolio of evidence to document that learning. This program also provides information about the growing numbers of institutions that regularly evaluate experiential learning for advanced standing or credit.

Research done in conjunction with the computer-assisted counseling systems demonstrates that computers are successful in avoiding implicit racial or sexual stereotyping of students. Blacks and women have reported that one of the reasons they like using the machines is the absence of bias that they often feel in white- and male-dominated settings. We also have learned from this research that the private nature of the interaction with computers makes learning and counseling easier and more acceptable to some students.

Instructing for the future

Microcomputers will eliminate significant numbers of jobs in manufacturing and production areas, but also will provide many new jobs in other areas. It is very difficult to predict the societal impact that the electronic revolution will have. Educa-

tional institutions must begin now to identify careers and occupations their graduates must be prepared for in the next decade: What are the skills, the competencies, the affective behaviors, that will be necessary in the new computerized world? How are we to prepare new workers, older workers, and former workers in a society where the whole definition of work will be radically affected within the next 10 years?

Colleges and universities must immediately attend to the value questions that surround this new revolution. What are the implications for economic redistribution? What are the implications for the transmission of cultural value systems? What are the political implications of the widespread availability of data and information, not only in developed countries, but in the poorer and less developed nations of the world? Perhaps this is the arena that is the most important and the most difficult for us to address. Being unable to completely and accurately predict the nature of the changes that will occur, we are faced with great difficulty in preparing people for that change. But if we fail to do so, the personal and economic consequences for our value system and our society are potentially devastating.

What do we do as educators? First, I believe it is absolutely essential that we not align ourselves with the resisters to the new technology. We will be no more successful in stopping this revolution than the original Luddites were. Rather, we must begin immediately to insert our ideas into the marketplace so that the issues and approaches that are important to education in the past will have an opportunity for survival. Second, we must establish linkages with the businesses and industries that have the resources and skills to accomplish much of what will happen in the future. I believe that we would find considerable interest on the part of business and industry to assist in the development of educational programs that use the new technology, drawing on the strengths of our educational institutions.

Third, we must prepare to invest significant sums of money into the research and development necessary to creatively use the new technologies for educational purposes. Where we shall get these funds in an era of declining budgets is a difficult question, but it is absolutely essential for the survival of our educational institutions as we know them today. Fourth, we must create new alliances and cooperative working arrangements with other educational institutions; pooling resources and talent to increase our likelihood for success.

Fifth, we must prepare our faculty for the changes that lie ahead. The first step in that process undoubtedly will be nothing more than consciousness-raising. But it must be followed by increasingly detailed training to release the creative capabilities of our faculty in developing and implementing instructional programs that draw on our current curricula. Sixth, we must carefully examine our curricula and make those changes necessary stemming from the employment changes and values issues discussed earlier.

Finally, we must ourselves begin to learn as much as possible about what is about to happen with the arrival of personal computers. Find a course and take it. Get a microcomputer and use it. Visit a local microcomputer dealer and see what is available. And finally, read. (That may seem a little ironic, but since this publication is not yet on videodisc or microcomputer, I suppose it is acceptable.) An old-fashioned reading list appears at the end of this article.

One of the primary consequences if we fail to begin addressing the issues arising from the personal computer revolution may well be that our institutions of higher education will see their legitimacy undermined. High school students with knowledge of microcomputer capabilities may find their college faculties uninformed, uninterested, and resistant to the use of personal computers. Will these new students have difficulty being served in a system of higher education that does not recognize the importance of such a valuable learning tool as the microcomputer?

Ultimately, if we fail to meet the challenges of the personal computer revolution, the outcome could be as great as Papert suggests: that schools and colleges must transform themselves into something new or they "will wither away and be replaced." Short of that, we could easily see the primary delivery of education move from educational institutions to businesses and private entrepreneurs. The impact of business will be very significant in any event, but it will be even greater if we do not invest time, effort, and resources immediately.

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